

## ABSTRACT

Modified bacterial surface layer (S-layer) proteins are disclosed where the modification is the insertion, at an internal location, of a heterologous polypeptide, or polypeptide of interest. The polypeptide is a binding or target protein, such as an antigen or antibody, or part thereof, in particular a bacterial antigen (e.g. from *Clostridium tetani* such as TTFC). The modified surface layer protein can then be expressed on the surface of the bacterial cell and used in a vaccine. Also disclosed are bacteria which have been modified to express a heterologous surface layer protein, but which do not as a wild-type possess an S-layer (such as *L. casei*), and modified bacteria which express only a modified surface layer protein (and not the wild-type S-layer protein). The wild type S-layer is completely replaced with the modified version where the polynucleotide encoding the modified version is integrated into the bacterial genome. The modified S-proteins can form crystalline arrays, sheets or layers that can be used to bind functional molecules (e.g. receptors) to solid surfaces (Au, silicon wafers) in biosensors.